CHEMICAL AND BIOLOGICAL DEFENSE PROGRAM

General Information

In response to Congressional interest in the readiness and effectiveness of U.S. Nuclear, Biological and Chemical (NBC) warfare defenses, Title XVII of the National Defense Authorization Act for Fiscal Year 1994 (Public Law 103-160) required the Department of Defense (DoD) to consolidate management and oversight of the Chemical and Biological Defense (CBD) program into a single office within the Office of the Secretary of Defense. The public law also directed the Secretary of Defense designate the Army as the Executive Agent for coordination and integration of the CBD program. The executive agent for the SBIR portion of the program is the Army Research Office-Washington (ARO-W).

The objective of the DoD CBD program is to enable U.S. forces to survive, fight and win in chemical and biological warfare environments. Numerous rapidly-changing factors continually influence the program and its management. These forces include declining DoD resources, planning for warfighting support to numerous regional threat contingencies, the evolving geopolitical environment resulting from the breakup of the Soviet Union, U.S. participation in the Chemical Weapons Convention, and the continuing global proliferation of chemical and biological weapons. Improved defensive capabilities are essential in order to minimize the impact of the use of such weapons. U.S. forces require aggressive, realistic training and the finest equipment available that allows them to avoid contamination, if possible, and to protect, decontaminate and sustain operations throughout the non-linear battlespace. Further information about the DoD CBD Program (and related programs) is available at the DoD Counterproliferation and Chemical Biological Defense Homepage at Internet address http://www.acq.osd.mil/cp/.

The overall objective of the CBD SBIR program is to improve the transition or transfer of innovative CBD technologies between DoD components and the private sector for mutual benefit. The CBD program includes those technology efforts that maximize a strong defensive posture in a biological or chemical environment using passive and active means as deterrents. These technologies include chemical and biological detection; information assessment, which includes identification, modeling and intelligence; contamination avoidance; and protection of both individual warfighters and equipment.

Tri-Service Program

The U.S. Army, Navy, and Air Force have developed separate SBIR topics for research and development in various CBD areas of interest. As lead agency, the Army will coordinate Tri-Service efforts related to the receipt, evaluation, selection, and award of Phase I proposals and similarly for potential follow-on Phase II efforts under this program.

Topic Submission

All proposals submitted in response to CBD topics must be mailed to the address provided below. Potential offerors must follow the proposal submission rules for the agency which has proponency for topics. Topics are numbered in series, with Army topics starting at 101, Navy topics starting at 201, and Air Force topics starting at 301. Detailed instructions for proposals to be submitted against Army topics are given below. **Refer to the appropriate Navy and Air Force sections in this Solicitation for information on how to prepare proposals for submission against Navy and Air Force CBD topics.**

Notice for Navy proposers: The Army Research Office-Washington is not equipped to handle online (Internet or e-mail) proposal or Appendix A & B submissions. For all Navy proposals, an original and four copies must be submitted to the address provided below. Supplementary diskettes required by the Navy will also be accepted.

Army Proposal Guidelines

The Army has enhanced its Phase I-Phase II transition process by implementing the use of a Phase I Option that the Army may exercise to fund interim Phase II activities while a Phase II contract is being negotiated. The maximum dollar amount for a Phase I feasibility study is $70,000. The Phase I Option, which **must** be proposed as part of the Phase I proposal, covers activities over a period of up to four months and at a cost not to exceed $50,000. All proposed Phase I Options must be fully costed and should describe appropriate initial Phase II activities which would lead, in the event of a Phase II award, to the

successful demonstration of a product or technology. **The Army will not accept Phase I proposals which exceed $70,000 for the Phase I effort and $50,000 for the Phase I Option effort**. Only those Phase I efforts selected for Phase II awards through the Army's competitive process will be eligible for exercise of the Phase I Option. To maintain the total cost for SBIR Phase I and Phase II activities at a limit of $850,000, the total funding amount available for Phase II activities under a resulting Phase II contract will be $730,000.

Companies submitting a Phase I proposal to the Army under this Solicitation must complete the Cost Proposal, Appendix C, within a total cost of $70,000 (plus up to $50,000 for the Phase I Option). Phase I and Phase I Option costs must be shown separately; however, they may be presented side-by-side on a single Appendix C. The Phase I Option proposal must be included within the 25-page limit for the Phase I proposal. In addition, all offerors will prepare an Appendix E, Company Commercialization Report, for each proposal submitted. Appendix E does not count toward the 25-page limitation.

Selection of Phase I proposals will be based upon scientific and technical merit, according to the evaluation procedures and criteria discussed in this solicitation document. Due to limited funding, the Army reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality will be funded.

Proposals not conforming to the terms of this solicitation and unsolicited proposals will not be considered. Awards will be contingent on availability of funding and successful completion of contract negotiations.

Army Phase II Proposal Guidelines

Phase II proposals are invited by the Army from Phase I projects that have demonstrated the potential for commercialization of useful products and services. The invitation will be issued by the Army organization responsible for the Phase I effort. Invited proposers are required to develop and submit a commercialization plan describing feasible approaches for marketing the developed technology. Fast Track participants may submit a proposal without being invited. Cost-sharing arrangements in support of Phase II projects and any future commercialization efforts are strongly encouraged, as are matching funds from independent third-party investors, per the SBIR Fast Track program (see section 4.5). Commercialization plans, cost-sharing provisions, and matching funds from investors will be considered in the evaluation and selection process, and Fast Track proposals will be evaluated under the Fast Track standard discussed in section 4.3. Phase II proposers are required to submit a budget for a base year (first 12 months) and an option year. These costs must be submitted using Appendix C, Cost Proposal, and may be presented side-by-side on a single Cost Proposal Sheet. The total proposed amount should be indicated on Appendix A, Proposed Cost. Phase II projects will be evaluated after the base year prior to extending funding for the option year.

The Army is committed to minimizing the funding gap between Phase I and Phase II activities. With the implementation of Phase I Options all Army Phase II proposals will receive expedited reviews and be eligible for interim funding. Accordingly, all Army Phase II proposals, including Fast Track submissions, will be evaluated within a single evaluation schedule.

Mailing Address for all CBD Proposals

**Offerors using non-government courier services assume the risk for late delivery of proposals.*

Dr. Kenneth A. Bannister
U. S. Army Research Office - Washington
Room 8N23
5001 Eisenhower Avenue
Alexandria, VA 22333-0001
Telephone: (703) 617-7425

Key Dates

99.1 Solicitation Open	1 December 1998 – 13 January 1999
Phase I Evaluations	January - April 1999
Phase I Selections	April 1999
Phase I Awards	May 1999

PROPOSAL CHECKLIST

This checklist is provided to assist in preparing your proposal for submission. Please review the checklist carefully to assure that you proposal meets the SBIR requirements. Failure to meet these requirements may result in your proposal being returned without consideration. Do not include this checklist with your proposal.

_____1. The proposal budget adheres to the individual Service criteria specified.

_____2. The proposal is limited to only one solicitation topic.

_____3. The proposal (plus the Phase I Option for Army topics only) is 25 pages or less in length. (Excluding company commercialization report.) Proposals in excess of this length will not be considered for review or award.

_____4. The Cover Sheet (Appendix A) has been completed and is PAGE 1 of the proposal

_____5. The Project Summary Sheet (Appendix B) has been completed and is PAGE 2 of the proposal.

_____6. The Technical Content of the proposal begins on PAGE 3 and includes the items identified in Section 3.4 of the solicitation.

_____7. The Technical Abstract contains no proprietary information, does not exceed 200 words, and is limited to the space provided on the Project Summary Sheet (Appendix B).

_____8. The proposal contains only pages of 8 1/2 x 11 size. No other attachments such as disks, video tapes, etc. are included.

_____9. The proposal contains no type smaller than 11 point font size (except as legend on reduced drawings, but not tables).

_____10. The Contract Pricing Proposal (Appendix C) is complete, is signed with an original signature, and is included as the last section of the proposal. (For Army topics the **Phase I and Phase I Option** costs must be shown separately on Appendix C).

_____11. The final proposal is stapled in the upper-left-hand corner, and no special binding or covers are used.

_____12. An original and four copies of the proposal are submitted.

_____13. The Company Commercialization Report, (Appendix E) in accordance with Section 3.4.n. is included. (This report does not count towards the 25 page limit)

_____14. Include a self-addressed stamped envelope and a copy of the Notification Form, Reference A, located in the back of the solicitation book, if notification of proposal receipt is desired. **No responses will be provided if these are not included with your proposal.**

_____15. The proposal must be sent registered or certified mail postmarked by the date specified in Section 6.2, or delivered to the Army SBIR Office no later than **January 13, 1999, 2:00 p.m. local time** as required.

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Army Topics

Navy Topics

Air Force Topics

CHEMICAL BIOLOGICAL DEFENSE FY99 TOPICS

CBD99-101 TITLE: Computational Fluid Dynamic Modeling of Agent Transport Through Protective Clothing Systems

TECHNOLOGY AREA: Chemical And Biological Defense

OBJECTIVE: Develop a computational fluid dynamic (CFD) model of a clothed human, which can be used for studies of the various transport phenomena affecting the thermal balance of soldiers wearing chemical protective uniforms under different environmental conditions, while at the same time accounting for the transport of chemical agents through the clothing system in vapor or liquid form.

DESCRIPTION: The geometric configuration of a protective clothing system (fit, air spaces, closures, and seals) may be just as important as clothing layer material properties to the total performance of the clothing system. Recent advances in CFD codes (unstructured grids, block/adaptive/moving grids), as well as in computational hardware (speed/memory), make it possible to create accurate engineering CFD models which can include the irregular shapes of a clothed human, as well as the extremely different length and time scales present in a typical computation (i.e. extremely thin clothing layers over a relatively large human body and irregular air spaces). Modern chemical protective garments provide high levels of protection against battlefield chemical threats, yet are often found to impose high levels of heat stress under certain environmental conditions. Transport through the clothing system involves diffusion of heat and moisture, convective air flows, and liquid water capillary wicking. Hygroscopic fibers may absorb water in vapor or liquid form and release the heat of sorption, which serves as an energy source within the clothing. Depending on the ambient environment, water vapor may condense in outer layers of clothing, which liberates the heat of condensation and serves as another heat source within the clothing. Many modern protective clothing systems also include polymeric membranes, which may be either a microporous hydrophobic polymer (e.g. polytetrafluoroethylene), or a very thin solid layer of a hydrophilic polymer (e.g. polyurethane). The various steps involved in sorption of liquid water or vapor into the membrane, diffusion through the structure, and desorption from the other side, are often complicated by the concentration-dependent permeation properties of many of the polymers in common use. All of these processes are time-dependent. Particularly for the hygroscopic materials, equilibrium does not take place within a matter of seconds, but may require time scales of minutes to hours. Since humans are rarely working at a sustained constant work level for hours on end, steady-state approximations to determine quantities such as total moisture accumulation within the clothing, total heat and mass transferred through the clothing, are often inaccurate since the steady-state heat and mass transfer properties are inapplicable. This project is aimed at providing a useful analysis tool for studies of the various transport phenomena affecting the thermal balance of soldiers wearing chemical protective uniforms under different environmental conditions, while at the same time accounting for the transport of chemical agents through the clothing system in vapor or liquid form. It addresses the current need for more realistic models of coupled heat and mass transfer through textile-based chemical protective materials which include phenomena such as liquid water wicking, condensation/evaporation within textile layers, concentration-dependent permeation behavior of semipermeable membrane laminates, phase change materials incorporated into clothing components, sorption behavior of hygroscopic textile fibers, and incorporating multicomponent transport, to account for effects associated with diffusion/ convection/sorption of organic vapor/liquids in addition to effects associated with the coupled transport of heat and moisture.

PHASE I: Application of a general CFD code to systems and geometries of interest in chemical protective clothing systems; i.e. modeling the correct geometry of a clothed soldier, including clothing air spaces and fabric properties, subjected to a given set of environmental conditions and chemical vapor challenges. The Phase I work will model a static clothed human form subject to convection/diffusion processes for heat and vapor/gas transport, with the clothing layers participating in vapor phase sorption phenomena only (liquid phenomena of wicking/evaporation/condensation would be deferred to Phase II).

PHASE II: Extension of the basic CFD model to incorporate moving grid capabilities to follow body and clothing movement ("pumping" effects). Account for more complicated transport phenomena such as aerosol transport and deposition, liquid wicking/evaporation/ condensation, general phase change phenomena such as sorption/desorption.

COMMERCIAL POTENTIAL: A usable CFD model of a clothed human will be useful for applications such as industrial chemical protective suits, comfortable sportswear, and industrial design of heating and ventilation systems for workspaces and transportation systems.

REFERENCES:

1. Gibson, P., Charmchi, M., "Coupled Heat and Mass Transfer Through Hygroscopic Porous Materials -- Application to Clothing Layers," Journal of the Society of Fiber Science and Technology, Japan (Sen-i Gakkaishi) 53, No. 5, May, 1997.
2. Gibson, P. Charmchi, M., "Integration of a Human Thermal Physiology Control Model with a Numerical Model for Coupled Heat and Mass Transfer Through Hygroscopic Porous Textiles," Paper No. 96-WA/HT-29 (reprint available from American

Society of Mechanical Engineers), Heat Transfer Session HT-10, 1996 International Mechanical Engineering Congress and Exposition , Atlanta, Georgia, November 17-22, 1996.

CBD99-102 TITLE: High-Speed, Rugged Tuner for Low Cost, Standoff Chemical and Biological Detection

TECHNOLOGY AREA: Chemical And Biological Defense

OBJECTIVE: Develop a high-speed, rugged tuning device to obtain enhanced selectivity and sensitivity of chemical and biological (CB) agent identification in a low cost standoff detector. This topic does not duplicate any topic in any other SBIR/STTR solicitation.

DESCRIPTION: This topic solicits innovative and creative solutions to a research and development (R&D) problem in achieving high-speed tuning. This project will establish the technical feasibility of producing a high-speed tuner for DoD LIght Detection And Ranging (LIDAR) standoff CB detectors for contamination avoidance and decontamination, and for identification of weapons of mass destruction (WMD) manufacturing. All innovative approaches are encouraged and will be considered, provided they meet Phase I and II technical goals.

As stated in the definition of the Joint Warfighting Capability Objective (JWCO) for CB Warfare Detection, the "Capability for standoff detection of biological and chemical agents is our single most pressing need." Also, the one of the 2 Counterproliferation JWCOs is stated as the "Capability to detect and evaluate the existence of a manufacturing capability for weapons of mass destruction (WMD)." Standoff CB detectors are under development within DoD to address these objectives, such as the Joint Service Warning and Identification LIDAR Detector (JSWILD), which is supported by the Laser Standoff Chemical Detection Defense Technology Objective (DTO). One of the most critical components of these detectors is the wavelength tuner.

Current LIDARs for standoff CB detection uniquely identify CB agent spectral features by utilizing wavelength tuners that are mechanical in nature. For example, the carbon dioxide (CO2) LIDAR uses a rotating polygon or galvanometer (see references 1 and 2) to move a mirror that images a fixed grating. This device is capable of switching wavelengths at rates of up to 200 Hz. However, it is susceptible to temperature and vibration shifts unless extraordinary measures are taken to minimize these effects. Even these measures are only marginally effective and they are quite costly as they raise the price of the unit by an order of magnitude. Thus, a rugged tuner is needed.

Recent technological advances allow utilizing the non-linear properties of electro-optic crystals to construct a high-speed (up to 10 kHz) solid-state electronic tuner. Because of the lack of moving mechanical parts, it could be completely immune from shock and vibration, much less costly, and more accurate, therefore providing greater reliability, selectivity, and sensitivity. Also, when used with high-speed solid-state lasers, it would be possible to scan very large regions of spectra in a search mode and identify areas of CB agent contamination in a fraction of a second. In addition, recent developments in solid-state lasers make it possible to construct highly efficient, high repetition rate transmitters that utilize less diodes for pumping the laser medium. Since diodes are a major portion of the cost of the laser, this quasi-CW pumping will lead to substantial cost reduction of standoff CB detectors. However, the current mechanical tuners cannot tune rapidly enough to take advantage of this approach. Thus, a high-speed tuner is needed.

Development of such a tuner directly supports both short-range (JSWILD) and long-range (Miniature Standoff Agent Detector) goals for Contamination Avoidance identified in the Joint Service Nuclear, Biological, and Chemical (NBC) Defense Research, Development, and Acquisition (RDA) Plan, and outlined in its Chemical Detection Roadmap. These standoff detectors also support Joint Service goals in Wide Area Decontamination by identifying and mapping areas of contamination. There is a very high commercialization potential for this technology, since the device will be capable of high-speed scanning in addition to high-speed tuning. High-speed scanners are used in a multitude of commercial electronic devices.

PHASE I: Laboratory demonstration of an all solid-state tuning device. The ability to tune an Optical Parametric Oscillator (OPO) shifted laser shall be demonstrated. The nominal wavelength tuning range shall be within the 3-5 micrometer band (8-12 um goal) and the tuning rate shall be at least 2 kHz.

PHASE II: The wavelength tuning range shall be extended to include the 8-12 micrometer band. At least 4 mJ shall be obtained within the 3-5 micrometer range and at least 0.2 mJ shall be obtained within the 8-12 micrometer range. The tuning device shall occupy a volume less than the current galvanometric tuner (0.05 cubic feet). It shall demonstrate immunity to temperature changes over the +40 to - 40 degree C range. Laser tuning shall remain accurate during the temperature tests so that at least 90% of the maximum energy is still available.

COMMERCIAL POTENTIAL: Phase III military applications include full-sized and miniature standoff CB detectors for contamination avoidance, decontamination, and counterproliferation. Other Phase III military applications include electro-optical systems requiring a high-speed tuning or scanning device, such as optical countermeasures, rangefinders, and designators. Phase III commercial applications include detectors for standoff environmental pollution monitoring. Other Phase III commercial applications include electro-optical systems requiring a high-speed tuning or scanning device, such as bar code and laser light scanners. Hence, a COTS device is envisioned for insertion into future military systems.

REFERENCES:
1. Fox, J. and Ahl, J., "High speed tuning mechanism for CO2 lidar systems," Applied Optics, Vol. 25, No. 21, pp. 3830-3834, Nov 1, 1986.
2. Gautier, C. and Fox, J., "Evaluation of a galvanometric scanner for rapid tuning of CO2 lasers," Review of Scientific Instruments 60 (3), pp. 322-326, March 1989.

CBD99-103 TITLE: Modular Microfluidic Packaging

TECHNOLOGY AREA: Chemical And Biological Defense

OBJECTIVE: Development of modular microfluidic systems for interfacing MEMS sensors with the macroscopic environment

DESCRIPTION: Microfabrication and MEMS technologies have enabled a new physical domain for microanalytical systems: the microfluidic domain. There has recently been considerable interest and funding of programs to build miniaturized chemical analysis and synthesis systems on a single chip, reminiscent of the integration of microelectronic devices into ICs. A fundamental problem still exists, however, which is interfacing these systems to the external, macroscopic world. Many new microfluidic devices are being developed, but their insertion into systems will remain limited by packaging difficulties, fluidic pumping, and the integration of disparate technologies into a single system. Much development is needed in the area of packaging of microfluidic systems as well as modular approaches which allow devices and subsystems from differing technologies to be integrated into compact systems. Developmental research in this area would include miniaturized fluid connector systems, sealing and pumping technologies, and breadboard approaches which allow different technologies to be assembled into systems without the use of small tubing. Such approaches might include fluidic analogs to a printed-wiring board, or lego-like building blocks which have standardized fluid ports. The development of any standards in this area would greatly accelerate the insertion of new microfluidic devices and analytical protocols into commercializable systems.

PHASE I: Current microfluidic systems will be cataloged and investigated and an evaluation of packaging and interface requirements will be made. From this investigation, modular approaches will be designed for the integration of various microfabricated sensor units into complete systems. One or more MEMS sensor devices will be selected for Phase II microfluidic integration.

PHASE II: A modular microfluidic system will be constructed and demonstrated. Integration with the MEMS sensor device(s) selected in Phase I will conducted for development of a complete biosensor system ready for field tests. Initial packaging and interface standards will be presented for possible incorporation into ASME or MIL standards.

COMMERCIAL POTENTIAL: Development of packaging and interface standards would greatly accelerate the insertion of new microfluidic devices and analytical protocols into commercializable systems. Such development would provide excellent infrastructure for many new product areas and would service a growing and lucrative product market.

KEYWORDS: Microfluidics, MEMS, biosemsors, modular interfaces

CBD99-104 TITLE: Nanoscale Electrochemical Biosensors

TECHNOLOGY AREA: Chemical And Biological Defense

OBJECTIVE: Development of nanoscale microelectrodes (nanoelectrodes) for integration into on-chip electrochemical microanalytical biosensor systems. Development of nanoscale microelectrodes (nanoelectrodes) for integration into on-chip electrochemical microanalytical biosensor systems.

DESCRIPTION: Electrochemical techniques are particularly attractive for miniaturized chemical sensor systems which must have a closely coupled electronic interface. Redox chemistry which can be driven through microelectrodes enables numerous analytical techniques to be performed. Such techniques can provide qualitative and quantitative information about the sample media due to the direct relationship between electric current and surface reaction rate and the direct correlation between electrode potential and redox potentials of the analytes. Numerous advantages are obtained by making the electrodes smaller: faster equilibration with the solution, smaller capacitance, higher packing density, and the ability to be integrated into on-chip microanalytical systems. Thus far, most microelectrodes have been on the order of a few tens of microns for both integrated arrays and single probes, and the selectivity of the analysis technique has been limited to the natural redox potentials of the analytes of interest, for example, heavy transition metals, organo-nitrate and organo-phosphorous compounds, and a few ionizable organic ligands. Much promise exists for pushing both of these present boundaries: decreasing the size of the electrodes and altering the redox potentials with modifier compounds. Producing arrays of electrodes with dimensions

substantially less than one micron will allow kinetic as well as compositional information to be obtained due to the increased response time of the electrode and its solution interface. Greatly improved chemical selectivity can be obtained by tagging high-selectivity antibodies or antigens with redox-modifying tags that can be readily distinguished through voltammetric scanning techniques. Similar selectivity can also be obtained through the use of functionalized surface coatings on the microelectrodes which limit the binding and redox characteristics of specific molecules. The development of these techniques will require existing expertise in electrochemical analytical techniques and microfabrication, along with necessary infrastructure for nanoscale device fabrication and molecular surface and ligand engineering.

PHASE I: The ability to fabricate nanoscale electrodes will be demonstrated. Units will be constructed which are considerably smaller than current microelectrodes (these are typically a few tens of microns) and demonstrated on a laboratory breadboard. Protocols for the use of redox-modifying tags with antibody-antigen systems will be developed.

PHASE II: A prototype system will be developed which employs arrays of nanoelectrode sensing elements coupled to an immunoassay for detection of chemical or biological threat agents. The prototype system will be small, rugged, highly portable and suitable for field testing. A plan for the manufacture of these biosensors into portable handheld units will also be developed.

COMMERCIAL POTENTIAL: These technologies build upon recently developed scientific knowledge of microelectrode and nanoelectrode behavior, and would be directly applicable for many DoD-related problems, including battlefield personnel and environment monitoring, clinical healthcare applications, industrial chemical and pharmaceutical development and quality control, and agricultural and metropolitan pathogen detection.

KEYWORDS: Nanoelectrodes, MEMS, redox, microfabrication, biosensors, immunoassay

CBD99-105 TITLE: Synthesis of HD-Related Hapten-Protein Conjugates

TECHNOLOGY AREA: Biomedical

OBJECTIVE: To acquire the materials necessary for the production of monoclonal antibodies useful for the development of a non-invasive immunodiagnostic test for exposure to sulfur mustard.

DESCRIPTION: Research plans for a monoclonal antibody based enzyme immunoassay to detect exposure to sulfur mustard require the custom synthesis of haptenic protein conjugates that can be used both as mouse immunogens to generate hybridomas and as solid phase antigens for immunoassay development. Our proposed analytical system makes use of the unique structure of the major mammalian urinary metabolite of sulfur mustard to detect and document exposure.

PHASE I: The required materials consist of two analogs of the symmetrical dimercapturic acid metabolite of sulfur mustard bis[(2-acetylamino-2-carboxyethylthio)ethyl] sulfone. The haptenic compounds would have to be modified to allow conjugation to each of two proteins. One of these haptens must be attached to the carrier proteins through the central sulfur atom. The other can be conjugated through one of the terminal carboxyl or amino groups. The carrier proteins in each case would be either KLH or porcine thyroglobulin and BSA. The molar ratio of hapten to protein in the final products must be quantitatively determined. The final preparation must be stable and form a homogeneous solution when dissolved in buffer at physiologic pH. 500 mg of each conjugate in freeze dried form is required.

PHASE II: Larger scale production (20-30 g lot) of the appropriate test antigens or other test compounds for preliminary development of the immunoassay.

COMMERCIAL POTENTIAL: The joint development of an immunoassay based test device to use in HD immunodiagnostics and forensic analysis in a battlefield or terrorist situation CDC, Other governments, state and local emergency Authorities.

REFERENCES:

1. Lenz, D.E., A.A. Brimfield and L.A. Cook. 1997. Development of Immunoassays for Detection of Chemical Warfare Agents. pp 77-86 in D.S. Aga and E.M. Thurman, Eds. Immunochemical Technology for Environmental Applications. American Chemical Society, Washington, D.C.

2. Lieske, C.N., R.S. Klopsic, C.L. Gross, J.H. Clark, T.W. Dolzine, T.P. Logan, and H.G. Meyer. 1992. Antibodies with Specificity to Sulfur Mustard. Immunol. Lett. 31: 117-122.

3. Brimfield, A.A., K.W. Hunter, D.E. Lenz, H.P. Benshop, C. Van Dijk and L.P.A. De Jong. 1985. Structural and Stereochemical Specifictiy of Mouse Monoclonal Antibodies to the Organophosphorus Cholinesterase Inhibitor Soman. Molecular Pharmacology. 28: 32-39.

4. Brimfield, A.A., D.E. Lenz, C. Graham and K.W. Hunter. 1985. Mouse Monoclonal Antibodies against Paraoxon: Potential Reagents for Immunoassay with Constant Immunochemical Characteristics. J. Agricultural and Food Chemistry. 33: 1237-1242.

KEYWORDS: Sulfur Mustard, Immunodiagnostics, forensics

CBD99-106 TITLE: Evaluation of Immune Response and Development of Improvements for Naked DNA Vaccines

TECHNOLOGY AREA: Biomedical

OBJECTIVE: Improvements to naked DNA vaccine delivery systems

DESCRIPTION: Vaccines that are administered in the form of "naked DNA" encoding immunogens of interest hold great promise for human use. Naked DNA vaccines are being evaluated for a variety of infectious disease agents and biological defense agents. This approach offers numerous advantages, such as the potential to immunize an individual against multiple immunogens simultaneously, the use of a common platform for vaccines against multiple agents, the lack of a requirement to grow pathogenic organisms for vaccine preparation, the the possibility of targeting specific immunological responses. The mechanisms for delivering such DNA, delivered typically as plasmids, have focused on direct intramuscular inoculation of the preparation, or by particle bombardment approaches where microscopic gold beads, coated with the DNA plasmids, are projected directly into the skin epithelial cells by electrostatic discharge of helium. Additional techniques to enhance DNA delivery to target cells involves placing the DNA molecules into a carrier system, such as a nanosphere or a liposome. The chief requirements for any delivery system of naked DDNA is that potency be maximized relative to the immunizing dose, and that the appropriate immune system response be stimulated leading to protective efficacy. A final consideration for improvement to naked DNA vaccine candidates is that the product be safe for human use.

PHASE I: Evaluate the naked DNA immune response to a specific biological threat agent, or infectious disease agent; e.g., vector-borne viruses, bacterial agents (plague, anthrax, brucella), or viral agents (alpha viruses, filo viruses, orthopox viruses). Develop alternative naked DNA vaccine delivery mechanism(s) that will lead to either enhanced protective humoral antibody production or to increased cellular immune response. Demonstrate the improvement in an appropriate challenge model. Improvement can be assessed for a variety of parameters, but most importantly, would be prioritized as 1) demonstration of greater than or equal to 90% protective efficacy, 2) acceleration (50%) in the time required to protective immunity, 3) increased duration (50%) of protective efficacy, or 4) broader spectrum of immunological response (e.g., cross-protective response across strains or species of pathogens). Evaluate animal safety of the alternative delivery system for eventual human use.

PHASE II: Develop scale up production procedures for the improved delivery system. Further characterize the immunological response. It is envisioned that a successful outcome would be a new method for enhancing immune response to a particular agent chosen as a model system by the SBIR applicant, e.g., a new procedure for delivering DNA, or incorporation of immunostimulatory sequences or co-factors encoded in the vaccine construct, etc. Should such a method prove promising for the target agent, the deliverable would include the developed vaccine construct as well as the information on an improved methodology for potential application with other agents of interest.

COMMERCIAL POTENTIAL: Naked DNA vaccine technology is an area of active investigation in the biologics industry for a variety of endemic bacterial, viral and protozoal disease threats. Evaluation of immunological responses to naked DNA vaccines leading to improvements in the design and delivery of such vaccines would have tremendous application in the commercial sector biologics industry. Development of effective and safe naked DNA vaccines for use by military populations would potentially realize logistical and cost savings by reducing the number of immunizations required in combination vaccines for multiple agents by using the naked DNA approach as a single delivery platform, and from development and manufacturing savings as a result of the greater degree of characterization of naked DNA vaccines and lowered risk relative to methods requiring production and storage of live agents.

REFERENCES:

1. Barnett, S. W., Rajasekar, S., Legg, H., Doe, B., Fuller, D. H., Haynes, J. R., Walker, C. M., & Steimer, K. S. (1997). Vaccination with HIV-1 gp120 DNA induces immune responses that are boosted by a recombinant gp120 protein subunit. Vaccine 15, 869-73.

2. Cardoso, A. I., Sixt, N., Vallier, A., Fayolle, J., Buckland, R., & Wild, T. F. (1998). Measles virus DNA vaccination: antibody isotype is determined by the method of immunization and by the nature of both the antigen and the coimmunized antigen. J Virol 72, 2516-8.

3. Chen, S. C., Jones, D. H., Fynan, E. F., Farrar, G. H., Clegg, J. C., Greenberg, H. B., & Herrmann, J. E. (1998). Protective immunity induced by oral immunization with a rotavirus DNA vaccine encapsulated in microparticles. J Virol 72, 5757-61.

4. Condon, C., Watkins, S. C., Celluzzi, C. M., Thompson, K., & Falo, L. D., Jr. (1996). DNA-based immunization by in vivo transfection of dendritic cells. Nat Med 2, 1122

5. Feltquate, D. M., Heaney, S., Webster, R. G., & Robinson, H. L. (1997). Different T helper cell types and antibody isotypes generated by saline and gene gun DNA immunization. J Immunol 158, 2278-84.

6. Fomsgaard, A., Nielsen, H. V., Bryder, K., Nielsen, C., Machuca, R., Bruun, L., Hansen, J., & Buus, S. (1998). Improved humoral and cellular immune responses against the gp120 V3 loop of HIV-1 following genetic immunization with a chimeric DNA vaccine encoding the V3 inserted into the hepatitis B surface antigen. Scand J Immunol 47, 289-95.
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KEYWORDS: Naked DNA Vaccine Immune Response Immunogens Nanosphere Liposome

CBD99-107 TITLE: Therapeutic intervention for control and prevention of pathologies associated with staphylococcal enterotoxins and pyrogenic streptococcal exotoxins

TECHNOLOGY AREA: Biomedical

OBJECTIVE: Develop pharmaceutical or biological products (nonvaccine) that will alleviate or prevent toxicologies or malaise caused by exposure to staphylococcal enterotoxins, streptococcal pyrogenic exotoxins and related exotoxins. Priority is given to proposals that have reasonable translational potential.

DESCRIPTION: Enterotoxins and pyrogenic exotoxins are virulence factors produced by Staphylococcus aureus and group A streptococci. The enterotoxins can cause acute, gastrointestinal disorders and a life-threatening toxic-shock syndrome may accompany parenteral exposure to any of these toxins. Current concepts suggest that toxicity is mediated by the release of pathological levels of proinflammatory cytokines, initiated by an overwhelming stimulation of the immune system. Proposals are solicited to provide new or previously existing pharmaceutical and biological products as prophylactic or therapeutic agents for the control of pathologies associated with these toxins. These agents may be used in combination with or as substitutes for vaccines. In addition, novel pharmacological substances that are useful for treating symptoms of toxin exposure, such as nausea and disorientation are also requested.

PHASE I: Demonstrate feasibility of specific pharmaceutical or biological products to control or prevent toxicities from exposure to staphylococcal enterotoxins and pyrogenic streptococcal exotoxins in ex vivo, in vitro, or experimental animal models.

PHASE II: Demonstrate efficacy of specific pharmaceutical or biological products to prevent toxic-shock syndrome in nonhuman primates or to alleviate pathological symptoms.

COMMERCIAL POTENTIAL: A high frequency of toxigenic S. aureus and group A streptococci strains colonize the human population. Toxic shock syndrome has emerged as a significant health threat to the general population and may be associated with respiratory infections, surgical or nonsurgical wounds, and a variety of other infections. Any successful treatment resulting from this effort will be useful for treatment or prophylaxis of toxic-shock syndrome within the public sector. Therapeutic interventions are needed for treatment of military personnel exposed to these toxins by: 1) infections of surgical or nonsurgical wounds, including combat injuries, 2) direct respiratory, dermal or mucosal infections, 3) secondary diseases of viral infections, 4) deliberate exposure from use as biological warfare agents.

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KEYWORDS: Pathologies, nonvaccine, staphylococcal, enterotoxins, pyrogenic, exotoxins, Therapeutic intervention, Prevention, Toxicologies, malaise, toxigenic S., proinflammatory cytokines, aureus, toxigenic, nonsurgical

CBD99-201 TITLE: Integrated Microfluidics And Optics For Miniature Biosensors

TECHNOLOGY AREA: Sensors

OBJECTIVE: Design and fabricate a handheld sensor including automated fluidics and optics for interrogating a sensing chip coated with an array of detector antibodies.

DESCRIPTION: Antibodies can be immobilized on a variety of glass and plastic surfaces in geometrically defined arrays. In a manually operated system, these arrays have been interrogated using evanescent illumination and a CCD for readout with detection of BW agents at the ng/ml level. The prototype used for such studies used a diode laser for excitation and simple microscope slides as waveguides. Simple, disposable components for sensors are required that include arrays of immobilized antibodies as sensing surfaces, fluidics for handling sub-ml volumes, and integrated optical components for signal generation. This disposable component should interface with a portable device containing the light source and detector, permanent fluidics components, and data readout electronics. The fluidics should be appropriate for handling complex sample matrices such as blood and groundwater.

PHASEI: Design sensing system and demonstrate performance of disposable component.

PHASE II: Fabricate device prototype integrating fluidics, optics, and data processing software and demonstrate assay sensitivity, speed, and reproducibility.

PHASE III: Design and fabricate a manufacturable prototypes of device and disposable components..

COMMERCIAL POTENTIAL: Such a sensor would provide on site testing capability for simultaneous analysis of multiple analytes. Applications in addition to the detection of biological warfare agents include pollution monitoring, infectious disease diagnosis, process monitoring, and detection of drugs of abuse.

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KEYWORDS: biosensor, microfluidics, integrated optics, multianalyte sensing

CBD99-202 TITLE: Advanced Materials/Processes for High Efficiency Particulate Air (HEPA) Filtration.

TECHNOLOGY AREA: Chemical And Biological Defense

OBJECTIVE: Investigate the acceptability/availability of materials and/or processes that offer significant improvements over the current collective/individual protection particulate filtration technology (i.e. High Efficiency Particulate Air (HEPA) filter).

DESCRIPTION: The current technology used to filter Nuclear, Biological, and Chemical particulates and aerosols, for individual and collective protection filtration systems, is a HEPA filter. The current HEPA technology consists of a glass fiber filter that traps NBC aerosols and particulates at an efficiency of 99.97% for a 0.3 micron particle. While effective, the current HEPA media has the following burdens: (1) induces a significant pressure drop, (2) inability to be effectively and easily

cleaned, (3) insufficient particle loading capacity (4) excessive cost of manufacture. It is highly desirable to identify a new particulate removal material and/or process, which improves the current HEPA filters performance while maintaining its collection efficiency and passive nature (i.e., does not require any power to function). A highly desired criteria is to substantially lower the pressure drop across the HEPA filter. The current HEPA filter media used in NBC collective protection filters imposes a substantial pressure drop across NBC filtration systems. This pressure drop forces motor blowers to demand more power from batteries and/or power generators to move air through an NBC filter. If the pressure drop across the HEPA filter were reduced the power savings from the NBC system could then be used to power other mission essential equipment, such as, auxiliary generators and computers.

PHASE I: Conduct preliminary laboratory testing and analysis, and provide an evaluation of the proposed material/process feasibility for eventual Joint Service use and probability of success to the government.

PHASE II: Conduct additional sub-scale testing to confirm laboratory scale results and sizing design methodology. Fabricate full-scale prototype and test IAW MITL-STD-810E to confirm feasibility.

COMMERCIAL POTENTIAL: Prepare for technology transition to Demonstration/Validation phase. Contractor shall construct prototype filters using an existing military filter platform and test. Provide report and recommendations to the government. HEPA and ultra-low particulate air (ULPA) filters are currently used in "clean rooms" to construct microelectronics. A low pressure drop HEPA/ULPA filter will have great utility in commercial application by reducing power consumption and the overhead cost to manufacture microelectronics.

KEYWORDS: particulate; filtration; high-efficiency; aerosol; HEPA; ULPA

CBD99-203 TITLE: Enhanced Technology for Chemical and Biological (CB) Agent Resistant Flexible Composites

TECHNOLOGY AREA: Chemical And Biological Defense

OBJECTIVE: Advance the state-of-the-art of flexible composites that can be used in tentage to provide CB agent protection. Improved performance and reduced cost will result in increased availability of CB protected tentage across the battlefield.

DESCRIPTION: There is a documented multi-service need for collective protection systems that will sustain operations and provide rest and relief in a CB agent contaminated environment (reference Joint Operational Requirements Document for a Joint Transportable Collective Protection System). Limited flexible composite materials are currently available for CB tentage applications. Deficiencies of the existing materials include high cost, labor intensive manufacturing techniques, lack of durability, and inadequate flame resistance. The goal of this project is to address these issues by focusing on technology advancements in any of the following areas: new material composites, improved manufacturing processes, or simplified fabrication techniques.

PHASE I: Explore new materials, methods, or processes to optimize the performance and affordability of CB resistant flexible composites. Clearly demonstrate the advance(s) by fabricating and testing samples/prototypes

PHASE II: Refine the technology demonstrated in Phase I. Transition sub-scale systems to full-scale. Fabricate full-scale prototypes that demonstrate the new advancement and test to prove out concept.

COMMERCIAL POTENTIAL: Successfully demonstrated technology could be transitioned into the Joint Transportable Collective Protection System or existing CB tentage such as the Chemically and Biologically Protected Shelter or CB Protected DEPMEDS. Advances in protective fabrics can be transitioned into protective clothing used for toxic cleanup. Although there is not a widespread need for CB protective tentage in industry, commercial tent and awning manufacturers are interested in materials that have protective films that are highly durable and shed dirt. New CB protective materials that are inexpensive and easy to fabricate with could be transitioned to this commercial area.

KEYWORDS: chemical warfare; biological warfare; fabrics; tents; shelters; films

CBD99-204 TITLE: 3D Chem/Bio Response Trainer

TECHNOLOGY AREA: Manpower, Personnel And Training

OBJECTIVE: Create a 3D virtual world to train medical & support personnel in chem/bio Incident Response setup, flow management, and decontamination.

DESCRIPTION: Saving lives immediately after a chemical or biological incident requires quick and accurate action. 3D virtual world technology can be used to train medical & support personnel in the setup of the different chem/bio response stations and areas (triage, decontamination, stabilization, etc.). Details of the Hot Zone, Warm Zone & Cold Zone could be shown in the safety of a 3D world. This type of system could be programmed with specific tests to ensure the user learns the key points.

PHASE I: Identify the most applicable 3D virtual world development tool. Produce a paper design of a typical chem/bio incident response operation. Construct a prototype visualization. Work with the chem/bio experts to create a relevant set of scenarios, including shipboard/shore-based and CONUS/OCONUS. Identify types of tests to build into the system..

PHASE II: Develop 3D virtual worlds for each chem/bio scenario identified in Phase I. Include each station and component. Create hyperjumps to key locations in the world. Focus on critical tasks that must be performed to keep casualties alive. Illustrate the interactions expected with civilian first responders in CONUS scenarios. Develop and integrate the testing requirements from Phase I.

PHASE III: Modify the 3D virtual world, viewer, interface, and help files to provide training to other government agencies, medical students, EMS, fire and police.

COMMERCIAL POTENTIAL: This system could be used by emergency incident response departments in major urban centers, at major trauma centers, in medical schools, etc.

REFERENCES:

1. The DoD Defense Modeling and Simulation Office website at http://www.dmso.mil/ contains information about modeling and simulation standards and many other reference materials.
2. The Navy Modeling and Simulation Management Office (http://navmsmohq.navy.mil/) maintains a repository of Navy M&S programs and tools along with links.
3. The Naval Air Warfare Center Training Systems Division website contains descriptions of ongoing applications of 3D tools (http://www.ntsc.navy.mil/bf/scitech/appres.htm).
4. The Army Simulation, Training, and Instrumentation Command website (http://www.stricom.army.mil/) lists a variety Army uses of 3D tools in simulation and training.

KEYWORDS: Chem/Bio, Training, Decontamination, Triage, Incident Response

CBD99-205 TITLE: Air Deployed Chemical And Biologic Sensor

TECHNOLOGY AREA: Chemical And Biological Defense

OBJECTIVE: The proposed effort involves adapting sonobuoy delivery and monitoring technology to provide forward placement of sensors for early warning of CB (Chemical Biological) agents.

DESCRIPTION: The requirement to develop technologies for early warning of CB agents is well documented (Navy STRG, Joint Warfighter S&T Plan, etc.). Currently programs are in place to develop small inexpensive CB sensors for deployment with personnel. However, the capability to obtain stand-off detection through forward placement of point detectors through air drops (as suggested by the Joint Warfighter S&T Plan) is not currently under development. The program proposed is to adapt sonobuoy delivery and monitoring technology for delivery and monitoring of CB sensors. Information from these sensors would be integrated into the C4I systems by programs such as JWARN (Joint Warning And Reporting Network) which are already in progress. Deployment of these sensors could be used to support amphibious landings or to investigate the safety of vacated/destroyed enemy positions which might contain CB agents.

PHASE I: The Phase I effort will investigate the feasibility of using sonobuoy delivery and monitoring technology to provide forward placement of sensors for early warning of CB agents. This will involve determining the feasibility of packaging advanced CB and associated environmental sensors within sonobuoy packaging constraints and modifying the sonobuoy RF link to transmit CB and environmental data to monitoring naval aircraft.

PHASE II: The Phase II effort will involve the fabrication and test of functional, but not air deployable, prototype units. The form factor of these units will be consistent with sonobuoy packaging constraints. These units will be fully functional and capable of detecting, as a minimum, the chemical agents required by the JCAD (Joint Chemical Agent Detector) program. These units will be capable of linking the CB sensor and related environmental data to naval aircraft for remote monitoring.

COMMERCIAL POTENTIAL: The Phase III effort will involve the fabrication of air deployable units which meet all the functional requirements of the Phase II units. Sufficient quantities will be produced to fully qualify the design for deployment from naval aircraft. The technology to be developed under this SBIR could be easily adapted for monitoring CB hazards and spills in situations where manual sensor placement is too dangerous.

REFERENCES:
1. Operational Requirements Document For A Joint Chemical Agent Detector (JCAD)
2. Operational Requirements Document For A Joint Biological Remote Early Warning System (JBREWS)

KEYWORDS: chemical biologic sensors, sonobuoys

CBD99-301 TITLE: Modeling of Mask and Machine Interfaces for Mask Design Optimization

TECHNOLOGY AREA: Chemical And Biological Defense

OBJECTIVE: Develop a parametric respirator computer aided design (CAD) model that accounts for the interface of the mask design with operational equipment

DESCRIPTION: Current limitations in process, software tools, and separate product development environments require mask systems to be designed and fabricated from scratch to support product development, prototyping, field testing, redesign, manufacturing, and distribution. Considering that this process must occur independently for every size mask that is needed to fit the diverse facial characteristics of the military, the precision of these methods is less than adequate and the entire process is extremely expensive and time consuming. New methods need to be developed that both improve the mask development process and produce a mask with an optimal design. Recent efforts have been initiated to address specific segments of the mask design process. A working methods document of a parametric model of mask faceblank development for a prototype version of the Joint Service General Purpose Mask (JSGPM) has been developed to show the feasibility of parametrically designing the JSGPM faceblank. Also, efforts are in progress to model the effects of contact pressures between the face-seal of the mask and the fit of the mask for both comfort and protection and to model the effects of mask design on soldier performance. This effort would develop new technologies to develop a mask computer design model that has the capability to encompasses all segments of mask design and its compatibility with operational hardware. For example, the model would be able to predict the effects that altering a mask's lens size has on the interface of the mask with binoculars and weapons platform sighting systems. It could also predict compatibility of mask designs with communication equipment and individual warrior items such as rifles and helmets. Such a model would be able to track CAD changes and update mask component dimensions as needed to ensure optimization for compatibility with equipment interfaces for all mask faceblank sizes. The model would also provide visual as well as objective feedback to mask designers for analysis of design results.

PHASE I: Develop the concept of the system in block diagram form that includes both existing and new component technologies, their proposed interactions, their specifications, and the operation of the model. Demonstrate the operation of the model starting with a simplified mock-up of a mask, demonstrate additional modules for analysis of internal and external interfaces, perform gross design changes to the initial mock-up, and show model output.

PHASE II: Further develop and create a working model (including all new modules) to account for all mask design factors and hardware interfaces using supplied CAD specifics of existing and prototype masks. Conduct testing to validate the computer model and its components based on data for an established mask system.

COMMERCIAL POTENTIAL: This computer design model would have significant use in both industrial and medical applications where respiratory protection is required. It would enable the most cost-effective design of new respiratory protective equipment with optimal wearer and equipment interface for these applications. Also, this model would help for applications where off-the-shelf respirator selection is desired because users would be able to select a mask that meets their needs for both protection and interaction with their workplace hardware.

REFERENCES: 1. Donahue, R J. Development of a Parametric Master Model and Methodology for Respirator Protection: Working Methods Documentation; Reference No. CVPS9702RJD. Computervision, Bedford, MA, August 1997.
2. Ghosh, K., L. Blaney, K. Clark, M. Hauser, and R. Perry. Respiratory Encumbrance Model: Phase I. Battelle Memorial Institute, Columbus, OH, 1997.

KEYWORDS: computer aided design, respiratory protective equipment, equipment interface, weapon sighting systems, sighting devices, mask

CBD99-302 TITLE: Detection of Biological Agents and Pathogens in Water

TECHNOLOGY AREA: Chemical And Biological Defense

OBJECTIVE: To assure operational effectiveness and safety of personnel working in a toxic chemical/biological combat environment with respect to safe potable water quality

DESCRIPTION: A requirement was recently established for a chemical and biological water agent monitor. The development of a portable, field-deployable instrument that is capable of identifying waterborne biological agents and pathogens is needed. This effort seeks experience and capability that can be utilized to develop advanced technology for rapid and reliable detection of waterborne pathogens. It involves development of three sequential processes: (1) efficient recovery of microorganisms from source or finished drinking waters, (2) processing recovered microorganisms to allow effective detection, and (3) nucleic-acid based detection for accurate pathogen identification. These processes will ultimately be transitioned into the automated water monitor.

PHASE I: Phase I will involve devising a novel strategy for effective recovery and reliable detection of waterborne pathogens. The strategy will take into account current best available technologies and feasibility with respect to application to an automated field-deployable detection system.

PHASE II: Phase II will involve demonstrating the effectiveness of the selected technologies and approaches for meeting the requirements of the water monitor with respect to detection sensitivity and accuracy as well as potential application for the portable, field-deployable water monitor unit.

COMMERCIAL POTENTIAL: Phase III military applications include manportable detectors for contamination in potable water, decontamination/water treatment of contaminated potable water, contamination avoidance, counterproliferation (collateral effects), and force protection. Commercial applications include detectors for environmental pollution monitoring in municipal water facilities and public waterways.

KEYWORDS: water systems, pathogens, detectors, biological warfare agent, DNA, PCR, microorganisms

CBD99-303 TITLE: Standoff Biological Discrimination

TECHNOLOGY AREA: Chemical And Biological Defense

OBJECTIVE: Develop an eyesafe, non-UV-fluorescence, manportable, laser-based technique and system to discriminate biological agents at moderate standoff distances (5-10 km).

DESCRIPTION: Innovative and creative solutions to a research and development (R&D) problem in moderate range standoff biological agent detection are needed. Possible detection techniques include dual-wavelength (ratioed) scattering and multiple wavelength (Differential Scattering/Differential Absorption Lidar – DISC/DIAL) scattering and absorption as well as single-wavelength, multiple scattering (on- versus off-axis). All approaches are encouraged and will be considered, provided they meet Phase I and II technical goals. The current state-of-the-art biological detection system is a helicopter-mounted 1 micron scattering detection lidar with a planned upgrade to eyesafe and a range of 30-50 km with no capability to discriminate between naturally occurring aerosol clouds and those associated with a BW release. Another lidar, the Short-Range Biological Standoff Detection System, is currently being developed for evaluation. This device will be able to detect the presence of biologically-active particles within a naturally occurring aerosol environment but it utilizes non-eyesafe ultraviolet light, is severely limited in range, is quite large, and must be operated in darkness for maximum sensitivity.

Naturally occurring atmospheric particles fall into the 0.3 to 0.7 micron range. On the other hand, particles onto which BW agent have been deposited are much larger (2-10 microns). Thus, it is possible to discriminate clouds of BW agents by measuring the relative amounts of the backscattered signal compared to ambient conditions. For example, it has been shown that the relative amounts of light backscattering for BW agents at two wavelengths, 1.5 and 3.5 microns, differ from background backscattering by factors of 2 and 50, respectively. These figures depend strongly on the indices of refraction and whether or not the dispersals were wet or dry, but they show that the effect is quite measurable and could be used to perform the discrimination task. Recent spectroscopic and test data indicate that it may be possible to discriminate BW agents in the 9-11 micron region via DISC/DIAL methods. It has also been reported that spectroscopic data indicate the presence of absorption features within the 3-5 micron atmospheric window. Early indications are that perhaps the biological growth media and/or binders can be discriminated with lidars. It had previously been suspected that this may be the case, but until recently, there was no efficient laser sources that were tunable within that region until the maturation of optical parametric oscillator (OPO) wavelength shifting techniques. Thus, it now appears that the DISC/DIAL technique may be useful in the standoff discrimination of BW agents in two different wavelength regions. Preliminary calculations show that identification of the bio-aerosols could be possible at ranges up to 10 km if the DIAL technique proves viable. Finally, there is a well-established principle that larger (Bio) particles will more efficiently produce multiple scattered (off-axis) light than smaller (natural) aerosols at single, near-IR wavelengths (i.e. 1.5 microns), thereby affording another means of discrimination.

PHASE I: Past efforts in UV-fluorescence and typical light scattering have produced limited results. Recent test and spectroscopic data in the non-UV wavelength regions have been collected and thoroughly analyzed. Specifically, recent spectroscopic data will be obtained for the biosimulant bacillus globigii (BG). Other materials including known binders for BW agents have also been examined as well as the effect of growth media. These data will be used to specify the design

characteristics and project the performance of a moderate range (5-10 km) IR/NIR lidar using a novel bio-discrimination technique.

PHASE II: Construct a manportable lidar that will emit wavelengths shifted to eyesafe regions by optical parametric oscillation (OPO) or other techniques. The lidar will be used in field tests to demonstrate that the proposed novel technique can be used to identify BW simulants from naturally occurring aerosols at ranges of up to 5-10 km.

COMMERCIAL POTENTIAL: Phase III military applications include manportable, standoff CB detectors for contamination avoidance, decontamination, counterproliferation, and force protection. Phase III commercial applications include detectors for standoff environmental pollution monitoring.

KEYWORDS: standoff detection, LIDAR, biological warfare agent, laser, early warning

CBD99-304 TITLE: Water Distribution Simulator

TECHNOLOGY AREA: Chemical And Biological Defense

OBJECTIVE: Development of a water distribution simulator that can be used for the generation of contaminated water using chemical/biological hazardous materials to evaluate developmental and operational effectiveness of systems designed to detect toxic chemical/biological agents in combat environment with respect to safe potable water quality.

DESCRIPTION: A requirement was recently established for a chemical and biological agent water monitor. This requirement calls for a portable, field deployable instrument that is capable of detecting and identifying both chemical and biological agents. Currently, there is no standard methodology or generation equipment that can be used to challenge potential candidates for meeting the water monitor requirements. The development of the water distribution simulator is needed to provide the appropriate challenges (both chemical and biological materials) in respect to the following situations: (1) source water, batch mode water samples from streams, lakes, ponds, and other water sources that can be treated to provide potable water, (2) water quality verification, batch/continuous sampling at water treatment facilities or mobile reverse osmosis treatment unit to ensure the quality of potable water after treatment, and (3) integrity of water distribution systems, batch/continuous sampling of piping network (in-line main water pipe) within a fixed facility, storage containers, and consumer use points (i.e. shower points, water faucets, decontamination stations, etc).

PHASE I: Phase I will be dedicated to developing the standard methodology and test equipment system design to meet the challenges established by chemical and biological agent water monitor requirements.

PHASE II: Phase II will focus on fabrication and demonstration of the water distribution simulator. The system will be evaluated against a "standard" set of materials/conditions which will be provided by the government. System flexibility, stability and reproducibility will be of greatest importance.

COMMERCIAL POTENTIAL: Phase III military applications include test methodology/equipment for contamination in potable water, decontamination/water treatment of contaminated potable water, contamination avoidance, and counterproliferation (collateral effects). Commercial applications include test methodology/equipment for detectors in environmental pollution monitoring in municipal water facilities and public waterways

KEYWORDS: water systems, pathogens, detectors, biological warfare agent, microorganisms, chemical warfare agents, test equipment, test methodology

CBD99-305 TITLE: Chemical/Biological Decontamination System for Aircraft Cargo and Maintenance Equipment

TECHNOLOGY AREA: Chemical And Biological Defense

OBJECTIVE: Develop a deployable delivery system for application of chemical/biological (C/B) agent decontamination materials to aircraft cargo and maintenance equipment contaminated with C/B warfare agents.

DESCRIPTION: Current Air Force doctrine prohibits transportation of contaminated cargo and equipment off a contaminated base. As a result, contaminated cargo can not be delivered, contaminated maintenance equipment can not be deployed to where it's needed. This severely limits the Air Force's ability to accomplish the airlift and logistics support missions following C/B agent attacks. A deployable, cargo and equipment decontamination delivery system that can efficiently decontaminate contaminated cargo and equipment on the flightline at forward operation locations is required. Although multiple approaches may have merit, a system that employs decontamination materials as an aerosol under pressure in a flexible, closed

environment appears to offer considerable promise. The envisioned system must not damage the cargo or equipment, must be safe for system operators to use and must be compatible with current and future cargo handling and flightline maintenance procedures. The objective of this effort does not involve development of new decontamination materials, but rather focuses solely design and demonstration on the delivery system by which cargo/equipment decontamination can be achieved. This system may also serve as a means for decontaminating cargo/equipment that has been contaminated with industrial chemicals.

PHASE I: Define system requirements, evaluate feasibility of candidate systems and develop preliminary design for a deployable system for flightline decontamination of aircraft cargo and maintenance equipment contaminated with C/B warfare agents or industrial chemicals. Design must include a concept of operations (CONOPS) for how the system would be integrated with in AF airlift and logistics operations. The design trade studies must address system size, weight, deployability issues, power requirements, system maintenance requirements and development and operational cost as well as other pertinent factors.

PHASE II: Refine the preliminary design, develop a prototype system and demonstrate it's operational effectiveness by conducting decontamination trials using simulated agents.

COMMERCIAL POTENTIAL: The proposed system would be directly applicable to decontamination needs of the international commercial aviation market. Federal, state and local agencies the world over could benefit from this technology in the event of either accidental or intentional contamination with C/B warfare agents or exposure to industrial chemicals in legitimate use by industry

REFERENCES: http://www.acq.osd.mil/cp/nbc97.html

KEYWORDS: decontamination, cargo handling, aircraft maintenance, chemical/biological warfare agents, industrial chemicals, flightline, airlift, logistics

CBD99-306 TITLE: Decontamination Indicator for Chemical Warfare Agents

TECHNOLOGY AREA: Chemical And Biological Defense

OBJECTIVE: Development of a family of highly reactive compounds that produce intense chromophores in the presence of chemical warfare agents.

DESCRIPTION: The current methodology used in the decontamination of chemical warfare agents is labor, material, and time intensive. The concept of a decontamination indicator would reduce the burden on the need to decontaminate every piece of equipment and personnel from a suspected contaminated environment. The decontamination indicator would "highlight" the contamination and identify only the equipment or personnel that is actually contaminated for the decontamination process. A fully successful decontamination indicator should have the following properties: (1) produce a color change that is visible in standard field lighting conditions or under a commercial off the shelf "black light" (available from any hardware store or stores similar to Wal-Mart/Kmart/etc.) to the presence of 0.01 gram/m2 of contamination (2) increase in chromophore intensity with a maximum color change in the presence of 0.25 gram/m2 of contamination (3) color change occurs in less than one minute with a duration of at least one hour (4) application of indicator material not to exceed 0.01 gram/m2 of the active compound (5) percentage of active compound must be at least 0.05% in non-aqueous solvents or 0.005 percent in aqueous solvents (6) overall cost of indicator/solvent should not exceed $250 per gram of active indicator used and (7) must be fully materials compatible with all military equipment.

PHASE I: Phase I will be dedicated to the development/identification, characterization, and laboratory demonstration of the candidate indicator compounds and the conceptual design of the applicator system for applying the indicator. The primary focus will be on the indicator compounds with the applicator design secondary.

PHASE II: Phase II will focus on optimization, fabrication and demonstration of the overall system after the indicator has been demonstrated using surety materials. The indicator will be evaluated against a "standard" set of materials/conditions which will be provided by the government.

COMMERCIAL POTENTIAL: Phase III military applications include contamination avoidance and decontamination. Commercial applications include the capability to identify environmental contaminated equipment and areas for clean-up or remediation.

KEYWORDS: decontamination, chromophores, chemical warfare agents